AN EVALUATION OF IMPACTS TO TERRESTRIAL HABITATS RESULTING FROM LEVEE CONSTRUCTION (2-A)

LIST OF TABLES (Cont)

JACKSON METROPOLITAN AREA, MISSISSIPPI

APPENDIX 2-A
AN EVALUATION OF IMPACTS TO TERRESTRIAL HABITATS RESULTING FROM LEVEE CONSTRUCTION

INTRODUCTION

BACKGROUND AND OBJECTIVES

1. The Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service (FWS), 1980a, 1980b) were used to quantify the potential impacts of constructing a comprehensive levee system along the Pearl River and provide flood protection to existing development in the Jackson metropolitan area. HEP is a habitat-based evaluation system that allows one to estimate current habitat conditions, predict future conditions, compare project alternatives, and devise mitigation strategies, all without the need for direct sampling of animal populations.

2. The objectives of this work were to (a) determine preproject (baseline) habitat suitability for selected wildlife species in the Jackson metropolitan area, (b) estimate potential impacts to each species under each project alternative, and (c) suggest mitigation measures or other design modifications to offset unavoidable habitat losses. Only direct impacts were evaluated. Direct impacts included land clearing, construction, and maintenance activities along the project right-of-way. Impacts due to construction of interior collector ditches, gated drainage structures, and pumping plants were not included.

AN OVERVIEW OF HEP

3. HEP is an accounting system for quantifying and displaying habitat availability for aquatic and terrestrial wildlife. HEP is based on habitat suitability index (HSI) models that quantitatively describe the habitat requirements of a species or group of species. HSI models use measurements of appropriate variables to rate the habitat on a scale of zero (unsuitable) to 1.0 (optimal). In a typical HEP study, a number of evaluation species are chosen for each cover-type of interest in the study area. Species may be chosen because of their ecological, recreational, or economic value, or because they represent groups of species; i.e., guilds, that have similar habitat needs (Roberts and O'Neil, 1985).

4. After cover types have been mapped and evaluation species chosen for the study area, habitat variables contained in the HSI models for each species are measured from maps, aerial photographs, or by onsite sampling. HSI values are then calculated, and the initial or baseline number of habitat units (HU) is

determined for each species. One HU is equal to 1 acre of optimal habitat; therefore, the number of HU's for a species is calculated as the number of acres of available habitat times its suitability (HU = HSI x acres).

5. HU's available to each species are estimated for each of several target years (TY) over the life of the proposed project (generally 50 to 100 years). Estimates of future habitat conditions are made for the "without project" alternative and for each "with project" alternative. Impacts on each species are then determined by calculating the difference in average annual habitat units (AAHU's) between with- and without-project alternatives. Development of mitigation plans involving tradeoffs of one sort of habitat for another may involve the use of relative value indices that express the relative priority or importance of the evaluation species or their habitats (Wakeley and O'Neil, 1988).

STUDY AREA AND METHODS

THE HEP TEAM

6. One of the strengths of the HEP process is the active participation of the concerned resource agencies through formation of a "HEP Team" to guide the evaluation, monitor its progress, approve intermediate results, and make changes in the direction, if needed. For the Jackson metropolitan area terrestrial habitat evaluation, the HEP Team consisted of Ms. Marge Harney (FWS), Dr. John Burris (Mississippi Department of Wildlife, Fisheries and Parks), and Mr. Bob Barry (U.S. Army Corps of Engineers, Vicksburg District) (CELMK). Other occasional participants in HEP Team meetings included Messrs. Steve Reed and Greg Ruff (CELMK).

STUDY AREA

7. The study area consisted of the land below the 300-foot contour, on either side of the Pearl River, from the dam at Ross Barnett Reservoir to an arbitrary point downstream of the city of Byram. The 300-foot contour was chosen because this is the elevation at the base of the dam, and it represented the extreme outer limits of the potentially impacted area. Within this area, the HEP Team agreed to concentrate efforts on determining direct impacts of project construction.

PROJECT ALTERNATIVES

8. Alternative project plans are summarized in Table 2-A-1. A range of alternative levees were analyzed. For display purposes, data presented in this document are for levee heights corresponding to river stages of 44.8, 47.7, and 48.8 feet on the Highway 80 gage. The plans are identified as Plans A, B, and C, respectively. In conjunction with the levee plan is 250 acres of overbank and bendway clearing to facilitate flows. Overbank clearing involves the removal of all trees and brush within 100 feet of the river bank. Bendway clearing consists of removal of all trees and brush in a 400-foot-wide swath across selected bendways. The clearing plan alternative involves partial or total clearing in the floodway. All clearing plans call for periodic maintenance of the cleared area to maintain hydraulic efficiency.

TABLE 2-A-2
STUDY AREA COVER TYPES BELOW 300-FOOT CONTOUR
FROM ROSS BARNETT DAM SOUTH TO BYRAM

Cover Type	Acres	Hectares	Percent
Hardwoods/BLH	31,075	12,576	53.6
Shrub/Cutover	6,368	2,577	11.0
Ag/Fallow	5,026	2,034	8.7
Pine-Hardwood	2,113	855	3.6
Grass/Pasture	1,703	689	2.9
Cypress/Tupelo	1,347	545	2.3
Pine Forest	1,181	478	2.1
Open Water	1,262	511	2.2
Sandbar/Bare	141	57	0.2
Urban	7,781	3,149	13.4
TOTALS	57,997	23,471	100.0

EVALUATION SPECIES

11. With consensus of the HEP Team members, seven species were selected for the habitat evaluation. The combined habitat requirements of these species were believed to reflect the important wildlife values of the various habitats in the study area. Four species--barred owl (Strix varia), gray squirrel (Sciurus carolinensis), Carolina chickadee (Parus carolinensis), and swamp rabbit (Sylvilagus aquaticus)--inhabit upland forests and forested wetlands in the study area. Barred owls prefer mature forests with closed canopies and large trees; gray squirrels also prefer mature forests, but with a variety and abundance of mast-bearing trees such as oaks and hickories. Carolina chickadees nest in small cavities in live trees or snags and forage in closed forests with abundant tree foliage. Swamp rabbits utilize moist forested habitats with dense understory and fairly open canopy.

12. The brown thrasher (Toxostoma rufum) inhabits the edges of grasslands, but prefers shrubland areas where it forages for invertebrates in the leaf litter. The eastern meadowlark (Sturnella magna) prefers open, grassy areas with nearby singing perches. The slider turtle (Pseudemys scripta) is a predominantly aquatic turtle that inhabits virtually all types of water bodies from rivers, ditches, and sloughs to lakes and ponds.

HABITAT SUITABILITY INDEX MODELS

13. Published HSI models were available for six of the evaluation species--barred owl (Allen, 1987a), gray squirrel (Allen, 1987b), swamp rabbit (Allen, 1985), brown thrasher (Cade, 1986), eastern meadowlark (Schroeder and Sousa, 1982), and slider turtle (Morreale and Gibbons, 1986). A model for the Carolina chickadee, developed by Rick Schroeder (FWS National Ecology Research Center, Ft. Collins, Colorado) for the Upper Steele Bayou Project Reformulation Study (1991) was used in this study. The model was based on an existing HSI model for the black-capped chickadee (Parus atricapillus) (Schroeder, 1983). Habitat variables used in the seven HSI models are listed in Table 2-A-3.

SAMPLING SCHEME

14. Habitat variables contained in the HSI models were measured during August 1992 by a single team composed of one biologist from CELMK and two personnel from Geo-Marine, Inc., Baton Rouge, Louisiana. The sampling scheme was designed to include all habitat types of concern within the proposed levee alignments, overbank and bendway clearing, and clearing plans.

15. Habitat variables were measured within 0.1-acre circular sampling plots located at the beginning, middle, and end of 1,000-foot transects. Prior to fieldwork, transects were laid out on 1:16,000 scale aerial photographs. Transects on proposed levee alignments were positioned to follow survey lines for cone penetrometer test locations. Transects to evaluate overbank clearing were established within 100 feet of the river's top bank.

PLOT SAMPLING

16. Habitat variables (Table 2-A-3) were either estimated directly or calculated later from data collected in the field. All data were collected on a 37-foot radius (0.1 acre) plot. In all, 115 plots were sampled on 38 transects throughout the project area (Table 2-A-4).

TABLE 2-A-3
HEP VARIABLE DEFINITIONS

Variable	Definition	Evaluation Species a/
CAV+SNG	Number trees w/ 1+ cavities plus # snags >4 in DBH	CC
SDIPS01	Mean distance to perch site (feet)	EM
VCVEM03	Percent cover of emergent herbaceous vegetation	ST
VCVHE01	Percent cover of herbaceous vegetation	EM
VCVLT03	Percent of ground area with litter >.5 inch deep	BT
VCVSH01	Percent cover of shrubs (woody plants <20 feet tall)	EM
VCVTR01	Percent canopy cover of trees	BO,BT,GS,SR,CC
VDBTR01	Mean DBH of overstory trees (in)	BO,GS
VDNSH02	Density of woody stems > 3 feet tall (#/ac)	BT
VDNTR04	Density of trees with DBH > 20 in (#/ac)	BO
VHTHE03	Mean height of herbaceous canopy (in)	EM
VHTTR01	Mean height of overstory trees (feet)	CC
VRCGR01	Percent of herbaceous canopy cover that is grasses	EM
VRCHM01	Percent of tree canopy cover hard mast species	GS
VSDHM01	Number hard mast species w/ canopy cover >1%	GS
WDP01	Mean water depth (feet)	ST
WRE01	Water regime code	ST
WVE01	Mean current velocity (feet/s)	ST
X125V5	Water temperature (degrees F)	ST

a/ Barred owl (BO), brown thrasher (BT), Carolina chickadee (CC), eastern meadowlark (EM), gray squirrel (GS), swamp rabbit (SR), slider turtle (ST).

TABLE 2-A-4
TERRESTRIAL HEP SAMPLING EFFORT

Transect Location	Number of Transects	Number of Plots
Northeast Jackson Levee	7	21
Southeast Jackson Levee	3	9
Laurelwood Levee	3	9
Flowood Levee	6	18
Richland Levee	4	12
Overbank Clearing	7	22
Bendway Clearing	2	6
Clearing Plans	6	18
TOTALS	38	115

17. Plots were first classified by cover type and then the tree layer was sampled. The tree layer consisted of all woody plants >20 feet tall, excluding vines. Trees rooted in the plot were classified visually as either overstory or understory, and identified to species. The DBH of each tree was measured to the nearest inch, and the average height of all trees (VHTTR01) was estimated visually and checked occasionally with a clinometer. Tree counts and DBH measurements were later used to calculate the mean DBH of overstory trees (VDBTR01), density of trees >20 inches DBH (VDNTR04), and the number of hard mast species with canopy cover >1 percent (VSDHM01).

18. Visual estimates of percent cover were made independently by each sampling team member, compared, and determined by group consensus. In forested plots, percent cover was estimated separately for all trees (VCVTR01) and hard mast species (VRCHM01). In cypress swamps, cover of emergent herbaceous vegetation (VCVEM03) was estimated. In grassland and shrubland habitats, herbaceous ground cover (VCVHE01), cover of grasses (VRCGR01), shrub cover (woody plants 3 to 20 feet tall) (VCVSH01), and percent of ground area with leaf litter >0.5 inch deep (VCVLT03) were estimated. Density of woody stems >3 feet tall (VDNSH02) was determined by either counting all stems within the plot or by subsampling a portion of the plot and extrapolation.

19. The variable CAV+SNG was estimated by adding the number of trees, living or dead, with one or more cavities >1 inch in diameter, found in the trunk or limbs >4 inches in diameter with the number of snags >4 inches in diameter and >6 feet tall.

20. The slider turtle model required estimates of mean water depth (WDP01), mean current velocity (WVE01), water temperature (X125V5), and inundation regime (WRE01). WDP01 was estimated by wading into the swamp and estimating depth at various points. Water temperature was measured using a thermometer submersed for at least 1 minute. WVE01 was estimated to be zero since all sample sites were natural impoundments with permanent water. WRE01 was required only for the slider turtle model. Since bottom-land hardwood sites were either temporarily or intermittently flooded, the value was optimal for swamp rabbits.

ANALYSIS OF IMPACTS

HSI DETERMINATIONS AND HEP SOFTWARE

21. HSI models were programmed into a standard spreadsheet program and habitat data for each sample plot in each cover type were entered into models for each appropriate evaluation species. An HSI value for each species on each plot was determined. HSI values for each species were averaged across all plots of similar cover type (Table 2-A-5). Average HSI values and cover-type quantities were used as input to the HEP software, provided by the FWS National Ecology Research Center, Ft. Collins, Colorado.

TABLE 2-A-5
HSI VALUES FOR EVALUATION SPECIES: MEAN (SE)

Species	Cover Type					
	BLH	MPH	PF	CYP	SHR	GRS
Barred owl	.57 (.04)	.59 (.11)	.60 (.12)			
Carolina chickadee	.77 (.03)	.85 (.11)	.93 (.04)			
Gray squirrel	.49 (.03)	.61 (.04)				
Swamp rabbit	.80 (.02)					
Eastern meadowlark						.62 (.14)
Brown thrasher					.29 (.08)	
Slider turtle				.33 (.10)		

PROJECT LIFE AND PERIOD OF ANALYSIS

22. HEP requires that habitat availability for each species be estimated, for each of several target years, over a period of analysis that may include the life of the project plus any additional preproject impact period. In the Jackson metropolitan area, the 100-year economic life of the project begins in 2005, following the 6-year construction period, and ends in 2105.

23. Work is projected to begin in 1998 and impacts will occur continuously between 1998 and 2004. To try and estimate impacts during construction, impacts were estimated to occur during a 5-year period. It was assumed that one-fifth of all impacts would occur by TY-1 and that all impacts would have occurred by TY-5. This approach slightly overestimated average annual impacts.

CALCULATING AVERAGE ANNUAL HABITAT UNITS

24. AAHU's were determined by annualizing the total HU's available over the 100-year economic life of the project. Impacts of each of the project plans were determined by calculating the net change in AAHU's between with-project and without-project alternatives for each evaluation species. HEP requires that all cover types available to a species be combined and a weighted HSI (weighted on the basis of acreage) be used in the analysis. Therefore, AAHU's for barred owls and Carolina chickadees are for BLH, MPH, and PF combined; for gray squirrels AAHU's are for BLH and MPH combined.

ASSUMPTIONS

25. For the baseline condition, it was assumed that two large cutover areas (approximately 1,240 total acres) within the study area would naturally succeed to bottom-land hardwoods. This assumption was based on the premise that the landowner would allow forest succession to occur for future timber harvest. It was also assumed that future harvests of timber in the study area would be accomplished on a small scale, or by selective cutting, which would not appreciably change the overall structure of the study area forests. Furthermore, these relatively small, localized changes would be offset by successional changes in undisturbed areas.

26. Based on projections made by the Mobile District in the Pearl River Basin Interim Report on Flood Control, it was assumed that additional urbanization would claim 5 percent of the habitat within the 300-foot contour study area. This assumption is predicated on the fact that little further development would occur below the 300-foot contour as a result of flood plain zoning restrictions and local experience with periodic flooding.

27. Since changes, over time, in many of the habitat variables which the HSI models incorporate (e.g., percent canopy cover, average DBH, etc.) can be predicted, it is possible to predict how habitat quality changes. For the barred owl, the most limiting variable in the HSI model was average tree diameter. Given the 100-year economic life of the project, and an average diameter growth rate of 2 to 3 inches per 10-year period, average tree diameter is predicted to increase significantly, thereby increasing the HSI. Habitat suitability for the gray squirrel in the study area is limited by the percent of the canopy composed of hard mast species. Over time, many of the smaller hard mast species would contribute a greater percentage of canopy cover since increases in tree diameter are positively associated with increased canopy cover. This change would increase HSI for gray squirrels.

28. Habitat suitability for Carolina chickadees was primarily limited by average tree height. While average tree height for most stands in the study area is probably at or near maximum, significant increases in height in plots where tree height was limiting could increase the overall HSI value for the chickadee. In addition, suitability for chickadees was limited on some plots by lack of suitable snags. Over the 100-year project life the number of suitable snags will probably not be limiting.

29. Habitat suitability for brown thrashers was most limited by the percent of ground area covered with litter at least 1 centimeter deep. Since litter tends to accumulate over time, this value will become less limiting over the life of the project. Thrashers are also limited by tree canopy cover. Since canopy cover is expected to increase, areas which are now suitable for thrashers will decrease in suitability as cutover areas succeed to mature forest. It was assumed that, with the exception of the large cutover areas mentioned previously, shrubland habitat would remain shrubland.

30. Given that suitability would change over time, additional assumptions concerning HSI values were necessary. It was assumed that by the end of the project life that (a) HSI values greater than 0.60 would become 1.00, (b) HSI values from 0.40 to 0.60 would become 0.70, and (c) HSI <0.40 would become 0.50.

31. For the with-project conditions, it was assumed that all acreage in the levee rights-of-way, associated overbank clearing areas, and total clearing alternatives (Plans D-1 and E-1) would be converted to grassland (GRS) habitat for the life of the project. For selective clearing alternatives (Plans D-2 and E-2), it was assumed that cover-type variables such as percent canopy cover and number of stems per acre would be reduced by 50 percent. Additionally, all acres of borrow areas were assumed to be converted to aquatic habitats regardless of whether borrow areas were located opposite levees or in satellite areas. Estimates of the amount of clearing for levee alternatives and clearing plans are provided in Tables 2-A-6 and 2-A-7, respectively. For clearing plans D-2 and E-2, habitat variables were adjusted, as stated above, and new HSI values calculated for each species for use in the HEP analysis for these alternatives.

TABLE 2-A-6
ACRES OF COVER TYPES IN RIGHTS-OF-WAY, BORROW AREAS,
AND LANDSIDE DITCHES, INCLUDING OVERBANK AND BENDWAY CLEARING,
FOR ALTERNATIVE LEVEE PLANS

Cover Type	Levee Plan					
	Opposite Borrow			Satellite Borrow		
	Plan A-1	Plan B-1	Plan C-1	Plan A-2	Plan B-2	Plan C-2
Bottom-land hardwoods	793	891	1,019	544	709	769
Mixed pine-hardwood	54	60	69	37	48	52
Pine forest	30	34	39	21	27	29
Cypress swamp	35	40	44	24	31	34
Grassland/pasture	74	102	91	64	78	84
Shrubland/cutover	277	379	336	238	288	312
TOTALS	1,263	1,506	1,598	928	1,181	1,280

NOTE: Areas of cover types were determined by their proportional occurrence in the study area.

TABLE 2-A-7
ACRES OF COVER TYPES IN ALTERNATIVE CLEARING PLANS

Cover Type	Clearing Plan			
	D-1 Total	D-2 Selective	E-1 Total	E-2 Selective
Bottom-land hardwoods	1,080	961	1,974	1,854
Mixed pine-hardwood	34	30	63	59
Pine forest	33	29	60	56
Cypress swamp	98	87	179	169
Grassland/pasture	1	1	3	2
Shrubland/cutover	156	138	284	267
TOTALS	1,402	1,246	2,563	2,407

NOTE: Areas of cover types were determined by their proportional occurrence in the study area.

RESULTS

LEVEE PLAN ALTERNATIVES

32. Habitat unit data (AAHU's) for evaluation species for each of the levee alternatives are presented in Table 2-A-8. Net changes in AAHU's due to alternatives are found in Table 2-A-9. While the barred owl, brown thrasher, gray squirrel, swamp rabbit, and Carolina chickadee lost AAHU's under all

levee alternatives, the slider turtle and eastern meadowlark gained AAHU's. This was due to the fact that borrow areas created turtle habitat and levee rights-of-way created meadowlark habitat. Within the three levels of protection, use of satellite borrow areas resulted in lower AAHU losses than use of opposite borrow areas, for those species which lost AAHU's. This was attributed to the smaller size of satellite borrow areas. Actual losses due to borrow pit construction could be considerably less if previously disturbed or low quality habitat areas are selected.

TABLE 2-A-8
AVERAGE ANNUAL HABITAT UNITS FOR LEVEE PLAN ALTERNATIVES

Evaluation Species	No Action	Opposite Borrow			Satellite Borrow		
		Plan A-1	Plan B-1	Plan C-1	Plan A-2	Plan B-2	Plan C-2
Barred owl	22,621	22,051	21,879	21,889	22,230	22,111	22,068
Brown thrasher	2,270	2,159	2,163	2,135	2,174	2,154	2,144
Eastern meadowlark	1,147	1,585	1,612	1,610	1,459	1,496	1,506
Gray squirrel	20,586	20,067	19,911	19,920	20,230	20,122	20,083
Slider turtle	566	780	867	895	725	801	832
Swamp rabbit	25,946	25,296	25,101	25,111	25,500	25,365	25,316
Carolina chickadee	31,671	30,873	30,632	30,645	31,124	30,957	30,897

TABLE 2-A-9
CHANGE IN AVERAGE ANNUAL HABITAT UNITS FOR LEVEE PLAN ALTERNATIVES

Evaluation Species	Opposite Borrow			Off-Site Borrow		
	Plan A-1	Plan B-1	Plan C-1	Plan A-2	Plan B-2	Plan C-2
Barred owl	-570	-742	-732	-391	-509	-552
Brown thrasher	-111	-107	-135	-96	-116	-126
Eastern meadowlark	+438	+465	+463	+312	+349	+359
Gray squirrel	-519	-675	-667	-356	-464	-503
Slider turtle	+214	+301	+329	+160	+235	+267
Swamp rabbit	-650	-845	-836	-446	-581	-631
Carolina chickadee	-798	-1,039	-1,025	-547	-714	-774

CLEARING PLAN ALTERNATIVES

33. Habitat unit data (AAHU's) for evaluation species for each of the clearing plan alternatives are presented in Table 2-A-10. Net changes in AAHU's due to clearing plans are found in Table 2-A-11. With the exception of the eastern meadowlark, all species lost AAHU's under total clearing alternatives. The eastern meadowlark gained AAHU's as a result of cleared areas being maintained in a grassland habitat type through yearly maintenance. The two partial clearing alternatives had lower AAHU losses due to the retention of some habitat value following partial clearing.

TABLE 2-A-10
AVERAGE ANNUAL HABITAT UNITS FOR
CLEARING PLAN ALTERNATIVES

Evaluation Species	Plan D-1		Plan D-2		Plan E-1		Plan E-2	
	No Action	Total Clearing	No Action	Selective Clearing	No Action	Total Clearing	No Action	Selective Clearing
Barred owl	761	3	677	344	1,391	6	1,306	664
Brown thrasher	64	2	57	13	116	3	109	26
Eastern meadowlark	1	587	1	1	2	1,072	1	1
Gray squirrel	696	3	619	417	1,273	5	1,196	804
Slider turtle	42	34	38	30	77	62	73	59
Swamp rabbit	907	6	807	1,008	1,658	8	1,557	1,945
Carolina chickadee	1,066	4	948	516	1,948	8	1,829	995

TABLE 2-A-11
CHANGE IN AVERAGE ANNUAL HABITAT UNITS
FOR CLEARING PLAN ALTERNATIVES

Evaluation Species	Plan D-1 Total Clearing	Plan D-2 Selective Clearing	Plan E-1 Total Clearing	Plan E-2 Selective Clearing
Barred owl	-758	-333	-1,385	-642
Brown thrasher	-62	-43	-113	-84
Eastern meadowlark	+586	0	+1,070	0
Gray squirrel	-693	-203	-1,268	-391
Slider turtle	8	-7	-15	-14
Swamp rabbit	-901	+201	-1,650	+387
Carolina chickadee	-1,061	-432	-1,940	-834

COMPENSATION ANALYSIS

MANAGEMENT PLAN SCENARIOS

34. To determine compensation acreages, the HEP software compares project-induced habitat unit losses with gains associated with specific management plan scenarios. Plans may be based on existing conditions in a candidate compensation area, or on hypothetical management areas. For this analysis, three compensation scenarios were developed.

35. The first scenario consisted of acquisition and management of forested land. It was assumed that (a) cover types on the management area occur in the same proportions as those in the Jackson study area, (b) HSI values were similar to those of the study area for without-project conditions, and (c) habitat could be managed to increase HSI values for each evaluation species during the life of the project.

36. The second scenario, restoration, consisted of converting agricultural lands to forested land, with a cover-type composition proportionally similar to that in the study area. It was assumed that the restoration effort could provide increased habitat suitability for most evaluation species during the life of the project.

37. The third scenario, reforestation, consisted of converting agricultural lands to hardwood forest. No attempt would be made to emulate a cover-type composition proportionally similar to that in the study area; however, high-quality hardwood species would be planted. It was assumed that reforestation could provide optimal habitat suitability for most evaluation species during the life of the project.

38. Compensation areas for levee alternatives ranged from 694 acres (Plan A-2, 100-year levee, satellite borrow) to 1,283 acres (Plan C-1, 500-year levee, opposite borrow) for the reforestation scenario (Table 2-A-12). Compensation acres for the restoration scenario ranged from 919 (Plan A-2, 100-year levee, satellite borrow) to 1,700 (Plan C-1, 500-year levee, opposite borrow). In the acquisition and management scenario, compensation areas ranged from 8,293 acres (Plan A-2, 100-year levee, satellite borrow) to 15,338 acres (Plan C-1, 500-year levee, opposite borrow). Compensation areas for clearing plan alternatives ranged from 511 acres (Plan D-2, reforestation) to 29,806 acres (Plan E-1, acquisition) (Table 2-A-13).

TABLE 2-A-12
COMPENSATION ACRES REQUIRED TO OFFSET LOSSES OF
TERRESTRIAL HABITAT DUE TO LEVEE ALTERNATIVES

Levee Plans	Acquisition		Restoration		Reforestation	
	Opposite	Satellite	Opposite	Satellite	Opposite	Satellite
Plan A	11,966	8,293	1,326	919	1,001	694
Plan B	14,484	10,771	1,605	1,194	1,228	901
Plan C	15,338	11,679	1,700	1,294	1,283	977

TABLE 2-A-13
COMPENSATION ACRES REQUIRED TO OFFSET LOSSES OF
TERRESTRIAL HABITAT DUE TO CLEARING PLAN ALTERNATIVES

Clearing Plan Alternative	Acquisition	Restoration	Reforestation
Plan D-1 (Total)	16,296	1,720	1,317
Plan D-2 (Selective)	5,186	672	511
Plan E-1 (Total)	29,806	3,146	2,408
Plan E-2 (Selective)	10,012	1,298	987

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MITIGATION PLAN (2-B)

JACKSON METROPOLITAN AREA, MISSISSIPPI

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MITIGATION PLAN

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INTRODUCTION

1. This mitigation plan is a proposal to implement mitigation through compensation for significant unavoidable losses that would result from implementation of the proposed Jackson Metropolitan Area, Mississippi, Flood Control Project. The mitigation measures include plans incorporated into the project design and development as well as measures to compensate for significant terrestrial habitat losses. Mitigation would be accomplished concurrent with project construction.

2. A Habitat Evaluation Procedures (HEP) (Appendix 2-A) study was used to quantify potential impacts of constructing a comprehensive levee system along the Pearl River and provide flood protection to existing development in the Jackson metropolitan area. The HEP is a system that uses a habitat-sampling approach to assess existing and future habitat conditions, compare project alternatives, and analyze mitigation measures to offset project impacts. In addition, personnel comprising the HEP team in conjunction with other study technical personnel developed environmental design measures that would both minimize adverse impacts associated with project implementation and minimize mitigation requirements. Environmental design and measures to minimize impacts include the following.

a. Levee alignment.

(1) Levee alignments were designed to leave as much area as possible on the riverside while providing for adequate storage of interior runoff. In addition, an alternative which would involve construction of a levee through LeFleur's Bluff State Park was rejected in favor of the floodwall adjacent to the businesses just outside the park. The proposed levee would have interfered with planned expansion of camping facilities, introduced an esthetically unpleasing site to the park setting, and contributed to the further fragmentation of bottom-land hardwood habitat in the basin.

(2) Other design measures to minimize impacts included shifts in the west bank levee upstream from Lakeland Drive. Just upstream from Lakeland Drive, the alignment was set closer to existing development to reduce impacts to a cypress-tupelo swamp created by beavers. The area could not be avoided entirely, however, due to the width of the proposed levee and proximity of residences. In the area upstream from Hanging Moss Creek, the alignment was shifted to follow the 16th section line to avoid a significant ecological area at the end of Westbrook Road.

b. Borrow pit design. Borrow pits (approximately 778 acres) would be designed to minimize clearing at the work site. The number of access points to each pit would also be minimized. In order to reduce direct impacts and provide habitat diversity, several small (5 to 10 acres) separate borrow pits would be utilized instead of one large continuous pit. Following extraction of borrow material, borrow pits would be modified to provide both shallow and deep water areas, with inclusion of peninsulas and/or islands. Trees and brush piles resulting from clearing would be configured to benefit wildlife instead of burning. Some felled trees would be placed perpendicular to the edge of each pit to provide access and loafing areas for certain wildlife species. Access roads and other disturbed areas around borrow pits would be seeded with wildlife food plants such as lespedeza or clover and replanted to hardwood species.

c. Overbank clearing in lieu of channel improvements. Construction of the proposed levees could adversely impact the Ross Barnett Dam by slightly increasing the Pearl River flood levels during major events. Considerations mitigating this potential adverse impact included overbank clearing between Lakeland Drive and the Ross Barnett Dam or channel improvements within that same area. Overbank clearing was chosen in lieu of channel improvements. To further minimize environmental impacts, the clearing was configured, to the extent practicable, to include previously cleared areas.

d. Slurry trenches in lieu of levee berms. During initial levee design, the plan incorporated large berms to prevent underseepage. However, after further study, it became evident that use of slurry trenches was preferred due to less damage to terrestrial habitat and lower maintenance costs. Although some borrow areas would be needed for slurry mixing areas, these could be reclaimed and returned to forested habitat.

3. Alternatives considered to compensate for unavoidable terrestrial habitat losses include:

a. Development of existing public lands.

b. Fee title acquisition and management of wooded lands.

c. Perpetual land use easement acquisition of wooded lands.

d. Fee title acquisition of cleared lands with reforestation.

NEED FOR MITIGATION

4. Implementation of the proposed Jackson Metropolitan Area, Mississippi, Flood Control Project would result in significant unavoidable adverse impacts to wildlife resources associated with bottom-land hardwoods. Compensation for this loss is a proper and positive consideration and requirement of multi-objective planning for water and related land resource development projects as defined in Section 906 of Public Law 99-662.

SIGNIFICANT RESOURCES

5. The U.S. Fish and Wildlife Service (FWS) classifies bottom-land hardwood habitat as Resource Category 2 defined as follows: "Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value."

6. Section 906(d) of Public Law 99-662, "Fish and Wildlife Mitigation," recognizes the national significance of bottom-land hardwoods by mandating that "Specific mitigation plans shall ensure that impacts to bottom-land hardwood forests are mitigated in-kind, to the extent possible."

7. Also, significant nonmonetary values have been institutionally ascribed by society at the national and international levels to preservation of wetlands such as the bottom-land hardwood forests in the Pearl River Basin.

MITIGATION PLANNING OBJECTIVES

8. Guidance on mitigation planning is provided in Engineer Regulation 1105-2-50, Chapter 2, and is stated as follows:

> "Fish and wildlife mitigation measures shall be evaluated according to their ability to either avoid, minimize, or compensate for adverse effects on significant fish and wildlife resources when compared to 'future without-plan' conditions. The extent of, and justification for, mitigation of the adverse effects of an alternative plan shall be based upon the significance of the resulting losses, compared to the combined monetary and nonmonetary costs required to carry out the mitigation measures. Justification shall not be based solely on the measure's ability to produce monetary benefits equal to its costs."

9. Adverse impacts of the project include the loss of 481 acres of cleared and 1,024 acres of wooded habitat. These physical losses to habitat and terrestrial wildlife are translated by the HEP of FWS to 3,408 average annualized habitat units (AAAHU), as presented in Appendix 2-A.

10. The mitigation planning objective for the Jackson metropolitan area project is 100 percent in-kind replacement of 3,408 AAHU's that are lost as a result of project-induced impacts on bottom-land hardwoods and associated terrestrial wildlife.

ALTERNATIVE MITIGATION PLANS

11. An array of four mitigation alternatives are identified and evaluated for their potential to compensate for the identified terrestrial habitat losses. A discussion and evaluation of each alternative are presented in the following paragraphs.

DEVELOPMENT OF EXISTING PUBLIC LANDS

12. This alternative mitigation plan addresses the possible further development and management of existing publicly owned lands in the project area. The rationale for public land use is with an incremental increase in habitat quality through development, AAHU losses attributed to the project can be offset, and thereby mitigate for bottom-land hardwood losses. The economic attractiveness of this alternative is the sunk cost of the existing land base, with management of the land the only cost. The biological disadvantage of this alternative is the unlikely ability to produce additional habitat units (HU) on existing lands that are already managed by state and Federal agencies. During the planning process for the proposed project, no agency has identified opportunities for more intensive management of their land or an alternative to the purchase of additional lands to mitigate for terrestrial habitat losses. Therefore, this alternative is not considered viable and was eliminated.

FEE TITLE WOODLAND ACQUISITION AND MANAGEMENT

13. The feasibility and effectiveness of this alternative mitigation plan are based on providing additional habitat quality (management potential) on existing woodlands. Management potential is a wildlife management and mitigation concept that assumes that net habitat losses can be offset through management of another parcel of land to incrementally increase the habitat value of that land and therefore compensate for project-induced losses. To obtain a gain in habitat quality, an acre of existing hardwoods must be manipulated to increase its existing value as wildlife habitat. Only the increment of increase can be used to offset annual HU losses. The management potential concept sounds reasonable, but it is questionable that the compensation calculations on paper are accurately translated to increases in habitat quality on the ground. Also, management measures which attempt to increase the habitat value of a particular wildlife species can contribute to the detriment of another species. With this mitigation philosophy, the following can occur:

a. Manipulated habitats do not increase carrying capacities of target species on an average annual basis.

b. Managed habitats for target species indirectly and adversely impact nontarget species.

c. Compensation for project losses as calculated is not complete.

d. More people compete for diminishing hardwood acres seeking outdoor recreation opportunities.

14. Based on the above discussion and rationale, and since large blocks of privately owned hardwoods suitable for acquisition and management within the Basin are already intensively managed for timber and wildlife by timber companies and/or hunting clubs, acquisition and management of existing privately owned bottom-land hardwoods to offset project-induced losses were eliminated.

PERPETUAL LAND USE
EASEMENT ACQUISITION

15. The basic requirement of the perpetual easement would prevent any change in existing land use in perpetuity from a hardwood forest. The feasibility of this alternative is based on the projected future large-scale conversion of bottom-land hardwood forests to agricultural row crops. However, since passage of the 1985 Food Security Act and the ineligibility for persons to receive certain U.S. Department of Agriculture program benefits after converting hardwoods/wetlands to agricultural producing lands, large-scale clearing of bottom-land hardwoods is unlikely to occur. Therefore, this alternative is not viable.

FEE TITLE ACQUISITION OF CLEARED
LANDS WITH REFORESTATION/REGENERATION

16. Significant acres of bottom-land hardwoods have been cleared in the Pearl River Basin and planted in row crops in response to favorable commodity prices. Today, with frequent flooding of some of these farmlands and other factors, portions of these lands are marginally profitable for agricultural row crop production. However, these lands are suitable and appropriate to use for compensation of project-induced bottom-land hardwood (wetland) losses. Also, reclamation of marginal farmland that has wetland functional values is consistent with the national goal of no net wetland loss. The reclamation (reforestation) of marginal farmland to bottom-land hardwoods (wetlands) as mitigation to compensate for terrestrial wildlife losses is also compatible with the general provisions of the Food Security Act of 1985. The purpose of the provisions of 7 CFR Part 12, "Highly Erodible Land and Wetland Conservation," is to "remove certain incentives for persons to produce agricultural commodities on highly erodible land or converted wetlands and to thereby:

a. Reduce soil loss due to wind and water erosion.

b. Protect the nation's long-term capability to produce food and fiber.

c. Reduce sedimentation and improve water quality.

d. Assist in preserving the nation's wetlands.

e. Curb production of surplus commodities."

17. The goals of the reforestation alternatives are to reestablish a functional bottom-land hardwood wetland forest community on low-lying, frequently flooded agricultural lands. This will be accomplished by encouraging the early growth of various species in a later successional forest that are valuable to wildlife. Planting oak species is the primary objective of the reforestation effort. Diversification will come from those volunteer species expected for the given growing conditions. Naturally regenerating species such as bitter pecan, green ash, persimmon, elm, willow, hackberry, and native understory plants will provide welcome diversity to recreate a forest environment ideal for supporting a wide range of wildlife communities.

18. Reforestation can be accomplished through natural regeneration or by accelerating natural succession through the introduction of seeds/acorns or seedlings. Various methods of reforestation are discussed. More than one method could be required to address all growing situations found. These methods of reforestation are discussed below.

Reforestation with Direct Seeding

19. Reforestation experience with soils having a high shrink-swell factor indicates that the direct seeding of acorns method of reforestation is more successful than planting seedlings. In the direct seeding of acorns, the soil closes around the acorns and stays closed. The direct seeding of acorns requires less time, effort, and expense than producing and planting seedlings. Also, direct seeding is recommended on suitable sites where all commercial trees have been harvested. The approximate cost per acre of direct seeding is depicted in Table 2-B-1.

TABLE 2-B-1
REFORESTATION COSTS WITH DIRECT SEEDING

Work Item	Cost Per Acre ($)
Site Preparation a/	10
Acorns and Pecans	9
Planting	77
TOTAL COST	96

a/ Not required if agricultural lands are planted immediately.

20. Managed lands reforested with seeds would have a per-acre annual cost of $206 for land acquired in the upper or project portion of the Pearl River Basin and $108 in the lower portion of the Basin. Approximately 2.77 AAHU's of benefit per acre would be provided to each area. The cost per AAHU would total approximately $74 and $39, respectively, for the project area and lower Basin.

Reforestation with Seedlings

21. The selection of mast-producing bottom-land hardwood species for reforestation with seedlings is recommended to produce a high quality forest that offers the desired species diversity.

22. A mechanical tree planter would reduce cost and increase efficiency over hand labor as indicated in Table 2-B-2. The tree species would be mixed depending on soil suitability before loaded on the mechanical planter. The trees would be placed on a 14-foot spacing to accommodate equipment. The cost per acre is depicted in Table 2-B-2.

TABLE 2-B-2
REFORESTATION COSTS WITH SEEDLINGS

Work Item	Cost Per Acre ($)
Site Preparation a/	10
Seedlings	100
Machine Planting (Hand Planting)	60 (75)
TOTAL COST	160 to 175

a/ Not required if agricultural lands are planted immediately.

23. The per-acre cost for planting seedlings ranges from 55 to 60 percent greater than planting seeds. Based on costs, this alternative is eliminated from further consideration.

Reforestation with Natural Regeneration

24. This method of reforestation should only be considered where available acorn sources do not exist. Natural regeneration of these types of areas would consist of undesirable light seeded, wind-distributed species with a

paucity of hard mast-producing trees such as oaks and pecans. Although this alternative is inexpensive, it does not meet the objective of guaranteed quality reforestation and desired mitigation results. Resource agencies would be relucant to manage such an area. This option is eliminated from further consideration.

SELECTED PLAN

25. Four alternatives means of mitigating the terrestrial losses in the proposed Jackson Metropolitan Area flood control project area were evaluated. Of these various methods, fee title acquisition of marginal farmlands with reforestation is the best method of mitigating the terrestrial losses. The planting of acorns and/or pecans with management is the selected method of reforestation. This is the least costly and most dependable plan that meets the mitigation planning objective.

26. To satisfy the planning objective of offsetting the 3,408 AAHU's that are lost would require acquisition, reforestation, and management of 1,228 acres of cleared agricultural lands. This is based on each acre providing approximately 2.77 AAHU's per acre gain. Estimated first cost for the two alternative areas of the Pearl River Basin considered is $2,990,000 and $1,471,000, respectively, for the project area and the lower Pearl River Basin. Table 2-B-3 provides detailed cost information. The annual cost is based on an interest rate of 7.75 percent and a project economic life of 50 years.

TABLE 2-B-3
SUMMARY OF COST DATA FOR FEE ACQUISITION OF CLEARED LANDS WITH REFORESTATION AND MANAGEMENT

Item	Unit	Total Cost ($)	
		Project Area	Lower Basin
First Costs			
Lands and Damages			
Real Estate Payments	1,228 ac	2,456,000 a/	936,200 c/
Appraisals		24,000	24,000
Public Law 91-646		5,000	5,000
Acquisitions		56,000	56,000
Total Lands and Damages		2,541,000	1,021,200
Development			
Reforestation	1,228 ac	117,888	117,888
Road Construction	4 mi	121,080	121,080
Survey and Establish Boundary	6 mi	4,530	4,530
Total Development		243,498	243,498
Planning Engineering and Design		206,000	206,000
TOTAL FIRST COSTS		2,990,498	1,470,698
USE		2,990,000	1,471,000
Annual Cost			
Interest (.0775)		231,725	114,002
Sinking Fund (.0019)		5,681	2,795
Boundary Maintenance	6 mi	300	300
Road Maintenance	4 mi	2,000	2,000
Timber Stand Improvement	250 ac	6,250	6,250
Timber Management	1,228 ac	3,684	3,684
Administration	25	3,375	3,375
TOTAL ANNUAL COST		253,015 a/	132,406 b/

$$\frac{\text{3,408 AAHU's Loss (as per HEP)}}{\text{1,228 Acres Required to Mitigate Losses (as per HEP)}} = \text{2.77 AAHU's Per Acre Gain}$$

$206 annual cost per acre ($253,015 ÷ 1,228 acres) a/
$108 annual cost per acre ($132,406 ÷ 1,228 acres) b/

a/ Cost within project area.
b/ Cost within lower Basin.

JACKSON METROPOLITAN AREA, MISSISSIPPI

APPENDIX 3
CULTURAL RESOURCES